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Thesis

SPACED LEARNING VERSUS UNSPACED

LEARNING IN SPELLING

Submitted by

Marjorie Armitage Oliver

(B.S. in Education, Massachusetts School of Art, 1937)

In Partial Fulfillment
of Requirements for the Degree of
Master of Education

1947

First Reader: Dr. Helen B. Sullivan, Professor of Education
Second Reader: Dr. Wm. C. Kvaraceus, Assistant Professor of Education
Third Reader: Dr. Donald D. Durrell, Professor of Education

BOSTON UNIVERSITY

SCHOOL OF EDUCATION

Gift of M.A. Oliver
School of Education
June 6, 1947
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(U.S. in Education, Massachusetts School of Ed., 1937)

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of requirements for the degree of

Master of Education

1947

First Reader: Dr. F. C. Johnson, Professor of Education
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Second Reader:
Third Reader:
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THE PROBLEM AND DEFINITIONS OF TERMS USED

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

I. THE PROBLEM

Statement of the problem. The aim of this study is twofold, namely: (1) to make a comparison of the growth in spelling achievement when using spaced learning versus the growth when using unspaced, or massed learning; (2) to find at what interval the most gain seems to be found, at twenty minute intervals three times a week, or at thirty minute intervals twice a week.

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Justification of the study. The results of the Blackford achievement Tests given in the eighth grades of the public schools of a city suburban to Boston for the year 1945 were definitely low in one subject, that of spelling. It was true not of just one grade nor of one building, but throughout the city to a noticeable degree in comparison with other subjects which were well above grade level. For that reason, a particular drive was made the following year to see what could be done to raise the spelling achievement. This study is based on the method of spelling carried out in the junior high grades for the years 1945 and 1946.

II. DEFINITION OF THE TERMS USED

Spaced learning. Spaced learning is a distribution of

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II. DEFINITION OF THE TERMS USED

Spaced learning. Spaced learning is a distribution of

practice. If a new poem is to be studied, as an example, it is believed by many investigators that a higher rate of learning may be accomplished by spacing the learning at different intervals. These intervals may be of varied length, perhaps a fifteen minute period every day or ten minutes twice a day.

Unspaced learning. Unspaced learning is a massing of practice. If this method was used the study of the poem mentioned above would be taught all at one sitting and for a much longer period of time.

III. ORGANIZATION OF THE REMAINDER OF THE STUDY

Organization. This study covered a twelve week period using students selected from three groups. One group had spelling once a week, the second group twice a week, and the third group three times a week. Fourteen students with comparable mental ages and spelling abilities were selected from each group making a total of forty two. Although all students in the three groups, totalling 118, participated in the experiment only the findings of the matched forty two were studied. The scope of the study and method of investigation will be found in detail in Chapter III.

Many investigations have been made concerning the best methods of teaching spelling as well as on the subject of spaced and unspaced learning. These studies, reported in part, may be found in the following chapter.

CHAPTER II

REVIEW OF PREVIOUS RESEARCH

The first part of this chapter will be concerned with previous investigations of spelling: as a social need, its importance as a tool subject, reasons believed causal in spelling disabilities, and various methods prescribed for spelling achievement. The second part deals with research conducted on massing of practice (unspaced learning) versus distribution of practice (spaced learning). This study is concerned with the possible effect of spaced learning on spelling.

CHAPTER II

REVIEW OF PREVIOUS RESEARCH

"Correct spelling is a condition of social approval as well as social respect, a recognized custom, as much a mark of respectability as good manners."¹ Along the same lines of thinking Wallin² states in his preface:

No person can be considered socially efficient, in all that these words imply, unless he is able skillfully to manipulate this tool. There are few elementary subjects in which inefficiency is more swiftly detected and more severely reprobated in later life than in spelling.

An increasing awareness of the importance of spelling in social living, often combined with a lack of success, has turned the attention of educators more and more to this field.

¹ WILLIAM F. TIDYMAN, The Teaching of Spelling (School Efficiency Monographs. New York: World Book Company, 1919), p. 91.

² JOHN E. WALLIN, Spelling Efficiency in Relation to Age, Grade and Sex and the Question of Transfer (Educational Psychology Monographs. Baltimore: Warwick and York, Inc., 1911), preface.

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"Correct spelling is a condition of social approval as well as social efficiency. It is an approved custom, as much a mark of respectability as good manners."¹ Along the same lines of thinking Wallin² states in his preface:

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Spelling was originally considered a memorization and drill exercise rather than a thinking process. Long columns of words were assigned. Many of these were in neither the child's speaking nor writing vocabulary and hence were of no use to him socially. Little attention was paid to the fact that spelling like other subjects must be taught, and that the learner must develop many skills in order to conform to the standards of good spelling usage.

The standard for spelling should be a practical one based on the needs of the child in his daily life. It has been said that:

Spelling is taught to enable a person to write correctly and rapidly his thoughts and ideas. To do this he must develop many skills. Poor spelling is the result of bad habits, and also the lack of ability to see and hear similarities and differences in words. To remedy poor spelling, it is necessary to substitute new and correct habits for those which have already been established.³

In more recent years, many studies have been made of various methods of teaching spelling, and spelling lists have been compiled of more commonplace words. However, Miller⁴ still believes that spelling lists could be sifted even more to eliminate unnecessary words and lighten the primary spelling

³ Mary Louise Neisler, "The Effect of Specific Training in Visual and Auditory Discrimination on Spelling," (unpublished Master's service paper, Boston University School of Education, 1945), p. 1.

⁴ Mary Margaret Miller, "Exercises in Auditory and Visual Training as a Means of Increasing Spelling Facility in Grade Three," (unpublished Master's service paper, Boston University School of Education, 1945).

load, listing only those words actually used by the children in writing.

At the other end of the pendulum, in direct contrast to the old "drill" method of teaching spelling, there developed the "incidental" method, whereby spelling was taught not as a subject, but only when the occasion demanded. Guile's⁵ study was made on the problem of which was more important in determining spelling accuracy, the learning that took place in the spelling period, or the learning that took place incidentally in connection with the child's other experiences. The tests were equated on the basis of average difficulty and, more important, on the basis of individual items. A parallel list of one hundred and fifty words that were in common usage was used versus the study list, one year after the words had been studied. Results showed that in each case the words studied were spelled with a higher percentage of accuracy, but the difference in no case was greater than 5 per cent. This is less than one fifth of the growth that took place over a two year period without formal instruction in spelling. Therefore the assumption that growth in spelling accuracy can be attributed solely to formal spelling instruction is not born out by the evidence in Guile's study. A special spelling

⁵ R. E. Guiles, "Effect of Formal Spelling on Spelling Accuracy," Journal of Educational Research, 37:284-89, December, 1943.

period devoted to the study of a basic list of words has only limited influence on spelling accuracy.

Wallin⁶ says, however:

.....
while a skillful spelling drill is not an unfailing cure
all for the forgetfulness of word forms, it does insure
a measure of habituation or organized stability that cannot
be reached by teaching spelling in a merely incidental
way. . . .

And in regards to transfer, Wallin⁷ also says:

We conclude, therefore, that column drills in spelling may produce a positive increment of spelling efficiency in dictated compositions or connected writing.

.....
The spelling proficiency developed in a drill situation
does transfer to a dictation or composition situation.

It is felt by many that the "incidental" method of spelling is prone to set up bad habits which will have to be unlearned before successful independent study can be attained. Book⁸ believes that if spelling is directed in a way which will teach the learner, from the beginning, how to study correctly and how to test and check his accuracy of spelling responses, that very little individual help will be needed and there will be no wrong habits to eliminate. Wallin's⁹ theory

⁶ Wallin, op. cit., p. 69.

⁷ Ibid., pp. 66-67.

⁸ W. F. Book and R. S. Hartner, "Mistakes Which Pupils Make in Spelling," Journal of Educational Research, 19:106-118, February, 1929.

⁹ Wallin, op. cit., p. 13.

coincides saying that a child should never know the incorrect form and then there would be no occasion for wrong suggestions to arise. Instead of unteaching, instruction should be essentially a process of teaching.

Several investigations made by Williamson¹⁰ of the influence of psychological factors upon spelling abilities show that there are at least three important factors involved:

1. The ability to perceive the essential features of "word form."
2. The knowledge of the meaning of specific words.
3. The general intelligence of the child.

Many other factors also influence spelling efficiency. Investigators find that the time element, effort of the pupil, interest, proper motivation, visual and auditory perception, correct pronunciation, and handwriting all bear an important part. Tidyman¹¹ concludes that one fifth of children's errors are due to the confusion of vowels having obscure or equivalent sounds, and over one half are due to the omission or insertion of silent letters.

Spache¹² contends that research is conflicting which

¹⁰ E. G. Williamson, "The Relation of Learning to Spelling Ability," Journal of Educational Psychology, 24:257-65, April, 1933.

¹¹ Tidyman, op. cit., pp. 56-57.

¹² George Spache, "Spelling Disability Correlates II - Factors that may be Related to Spelling Disability," Journal of Educational Research, 35:119-37, October, 1941.

clearly demonstrates that a defect in the skill of visual perception may be a causal factor in spelling failure; but both Gates¹³ and Durrell¹⁴ believe that the inability to remember or visualize the word form is one of the most common causes of misspelling.

Much research conducted on the best methods of overcoming a lack of visual perception finds many supporters of the flash card method of word study. Durrell¹⁵ says that flash cards are the best method for conquering visual difficulties. Suzzalo,¹⁶ because of their emphasis on speed and accuracy in observing the visual form of words, states: "To enforce full attention 'flash card' work has been used to compel the child to visualize quickly and accurately." McCarthy,¹⁷ in a comparison of the flash card method with the study-test

¹³ Arthur I. Gates, Psychology of Reading and Spelling with Special Reference to Disability (Teachers College Contributions to Education, No. 129, New York: Teachers College, Columbia University, 1922), p. 86.

¹⁴ Donald D. Durrell, Improvement of Basic Reading Abilities (Yonkers-on-Hudson, New York: World Book Company, 1940), p. 268.

¹⁵ Loc. cit.

¹⁶ Henry Suzzalo, The Teaching of Spelling (Riverside Press, Cambridge: Houghton Mifflin Company, 1913), p. 77.

¹⁷ M. G. McCarthy, "Comparison of the Flash Card Method of Teaching Spelling with the Study-test Method in Grades Two and Three," (unpublished Master's thesis, Boston University School of Education, 1942).

method of teaching spelling in the second and third grades, finds that there is a statistically significant difference of 7.68 in favor of the flash card method in Grade Two, and of a statistically significant difference of 14.66 in Grade Three.

A diagnostic study of spelling readiness conducted by Russell¹⁸ concludes that phonetic training is important in spelling achievement. In this study one group of first graders was given early and direct instruction in reading, phonetic analysis and handwriting. The second group had later and less practice in these language skills. The first grade test, as measured by Gates primary reading tests, showed that a program of direct instruction in reading that included early instruction in handwriting and phonetic analysis, produced better achievement in English spelling than a more incidental one with little phonics.

Concerning interest, Gates¹⁹ has this to say:

That lack of interest or application is frequently responsible for the lag of real achievement in spelling behind possible achievement, cannot be doubted. While the causes of the lack of interest or application are probably many, it is quite likely that ineffective methods of learning to spell are among them.

Kay²⁰ concluded in his investigation of the effect of

¹⁸ David H. Russell, "A Diagnostic Study of Spelling Readiness," Journal of Educational Research, 37:276-83, December, 1943.

¹⁹ Gates, op. cit., p. 72.

²⁰ M. E. Kay, "The Effect of Errors in Pronunciation upon Spelling," (unpublished Master's thesis, University of Iowa, 1927).

pronunciation upon spelling that an improvement in pronunciation was accompanied by an improvement in spelling, since training in pronunciation led to an increase of 23 per cent in the number of words correct in a spelling test.

Spelling is closely connected with reading ability, as poor readers are nearly always poor spellers, although the reverse may not be true. Acomb²¹ in his study says that it is very probable that spelling plays a definite roll in written recall, since disabilities along these lines would limit the recording of ideas assimilated from silent reading. He states in his conclusion that, "Spelling ability proved itself to be highly related to reading ability."²²

Investigations carried out on the effect of improving spelling through reading, one by Thorndike²³ and one by Gilbert,²⁴ both have a common conclusion, namely, that the

²¹ Alan Acomb, "A Study of the Psychological Factors in Reading and Spelling," (unpublished Master's thesis, Boston University School of Education, 1936), p. 72.

²² Ibid., p. 89.

²³ E. L. Thorndike, "Need of Fundamental Analysis of Methods of Teaching," Elementary School Journal, 30:189-91, November, 1929.

²⁴ Luther C. Gilbert and Doris W. Gilbert, "The Improvement of Spelling through Reading," Journal of Educational Research, 30:458-63, February, 1944.

most gain is made by superior spellers. Thorndike²⁵ states:

There is evidence to show that much of the learning and relearning or prevention of forgetting of spelling comes as a by-produce of reading. Some individuals, including many of the better spellers, obtain during ordinary reading, impressions which leave after-effects adequate to aid in spelling. . . .

However, Gilbert²⁶ also found that even the superior spellers failed to gain as much through reading as through direct study, and for the less able spellers he believed it probable that a gain in spelling would mean a loss in comprehension. The findings served to confirm the desirability of teaching spelling by a method stressing accurate speed of perception.

As a solution to the problem of the "best" method of teaching spelling, experimental researches on learning to spell, conducted by Winch,²⁷ indicate that a combined method of both auditory and visual presentation of spelling words is likely to be superior. Even more strongly Tidyman²⁸ has this to say, "An average of the results of three important investigations shows that the addition of speech and writing movements to visual and auditory presentation decreases the number of errors approximately one third."

²⁵ Thorndike, op. cit., p. 191.

²⁶ Gilbert, op. cit., pp. 458-63.

²⁷ W. H. Winch, "Experimental Researches on Learning to Spell," Journal of Educational Psychology, 4:525-37, November, 1913.

²⁸ Tidyman, op. cit., p. 62.

The problem of spaced learning versus unspaced learning has been the subject of much research and investigation. Lorge²⁹ used zero, one minute, and one day intervals between one-minute practice periods on the stabilimeter, and as a result of this study says, "Distribution of practice generally makes for economy. Under distribution of practice a fact is learned, or a skill acquired, with less work than if the practice were massed."

Dashiell³⁰ has stated that in learning any kind of habit it has been found, from a great number of researches, that it is more economical to space the practice with time intervals rather than to try to form it completely in one sitting.

Murphy,³¹ from an experiment conducted on the effects of time intervals on javelin throwing, says that the learning periods can be distributed by giving alternate days practice without the loss of learning. The conclusion reached from this study, in relation to school subjects, is that better work

²⁹ I. Lorge, Influence of Regularly Interpolated Time Intervals upon Subsequent Learning (Teachers College Contributions to Education, No. 438., New York: Teachers College, Columbia University, 1930), p. 1.

³⁰ John F. Dashiell, Fundamentals of General Psychology (Boston: Houghton Mifflin Company, 1937), p. 410.

³¹ Herbert Murphy, "Distribution of Practice Periods in Learning," Journal of Educational Psychology, 7:150-162, March, 1916.

can be done through a distribution of three times a week than through a distribution of five times a week, for the amount of time consumed.

Boring (et al.)³² state, "The conclusion is well established that, over a wide range of conditions, some form of positive distribution is a more favorable condition of learning than a zero distribution or massed practice."

Lyons³³ conducted a study using nonsense syllables and poetry at first. Digits and prose were then substituted. He concludes that it is obvious that ". . . the 'once-per-day' method is far more economical than the 'continuous' method, and gives also a far superior retention. This was found to be particularly true of nonsense syllables or digits."

Commins³⁴ states:

It has been found in general that the spacing or distribution of practice periods over a considerable length of time is more saving of the total time and effort spent in memorizing than trying to learn all the material at one or a few sittings. The advantages of spaced learning are especially noticeable for long time retention.

.

³² E. Boring, (et al.), Psychology, A Factual Textbook (New York: John Wiley and Sons, Inc., 1935), p. 321.

³³ Darwin O. Lyon, "The Relation of Length of Material to Time Taken for Learning, and the Optimum Distribution of Time--Part II," Journal of Educational Psychology, 5:85-91, January, 1914.

³⁴ W. D. Commins, Principles of Educational Psychology (New York: The Ronald Press Company, 1937), p. 411.

An experiment conducted by Starch³⁵ covered a six day period. The learning was divided into intervals of ten minutes, twice a day; twenty minutes, once a day; forty minutes, every other day; the entire task at one sitting. Within the limits of his experiment, the records show that the shorter and more numerous the periods of work are, the more rapid is the improvement. He says, however, that there would be a limit to how much the periods could be shortened and show benefits, as the advantages of shorter periods of work would be over balanced by the loss of adaptation at the beginning of each period. It is a well known fact that a period of rest after having studied something new gives it a chance to become settled and fixed. "There is, quite obviously, a point of diminishing returns, an optimal distribution and length of the period of work beyond which the expenditure of energy becomes less economical."³⁶

Of similar import is Boring's (et al.)³⁷ statement that, "Relatively short intervals are often more detrimental. Very long ones, particularly those which are longer than a few days, are almost always detrimental."

³⁵ Daniel Starch, "Periods of Work in Learning," Journal of Educational Psychology, 3:209-13, April, 1912.

³⁶ Ibid., pp. 212-13.

³⁷ Boring, (et al.), loc. cit.

Collins³⁸ has this to say after conducting her experiment on spaced learning in word analysis:

It would appear from this study that statistically, skills of word analysis are not retained better by spaced than by unspaced learning on either immediate or delayed recall. However, in spite of no statistical significance being found, the progression of gain shown in the experiment points to significance in itself.

.
The achievement under distribution of practice was generally superior to achievement under the massing of practice in this study.

Although Commins³⁹ coincides with the statement that the advantages of spaced learning are especially noticeable for long time retention, he also says that a number of conditions are found which call for qualifications of that statement. The length of rest period, the type and difficulty of the material, and the method of memorizing are all influencing factors. The massing of effort seems to be relatively unfavorable to the whole method of learning, but it is much less so, however, if stress is placed on detail and immediate recall.

Conclusions drawn from this research seem to indicate that a study of spelling based on a combination of best methods and carried out through a comparison of spaced and unspaced learning achievement, might prove to be worthwhile, from the standpoint of the writer's particular problem.

³⁸ Alice Collins, "Spaced Learning in Word Analysis," (unpublished Master's thesis, Boston University School of Education, 1941), pp. 41, 42.

³⁹ Commins, loc. cit.

CHAPTER III

SCOPE OF THE STUDY AND PLAN OF CONDUCT

The purpose of this study, as previously mentioned, is to make a comparison of the growth in spelling achievement when using spaced learning versus the growth when using unspaced learning. The following points are to be kept in mind throughout:

- 1. Is more gain found when using spaced learning or unspaced learning?
- 2. At what interval does the most learning seem to be found, at twenty minutes, at thirty minutes, three times a week or at thirty minutes five times a week?

CHAPTER III

SCOPE OF THE STUDY AND PLAN OF CONDUCT

This study was conducted with the cooperation of three groups totaling 180 pupils. The school program was set up arbitrarily, as the schedule following shows, and it was impossible to change pupils from one group to another. For this reason, although all 180 pupils participated in the experiment, only fourteen pupils from each group, or a total of forty two, could be selected for the study.

	Mon.	Tues.	Wed.	Thurs.	Fri.
Group 3	20 min.		20 min.		20 min.
Group 2	30 min.			30 min.	
Group 1			60 min.		

Schedule of Weekly Program

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This study was set up within the framework of three groups totaling 180 pupils. The school program was set up arbitrarily, as the schedule following shows, and it was impossible to change pupils from one group to another. For this reason, although all 118 pupils participated in the experiment, only fourteen pupils from each group, or a total of forty two, could be selected for the study.

	Mon.	Tues.	Wed.	Thurs.	Fri.
Group 3	20 min.		20 min.		20 min.
Group 2	30 min.			30 min.	
Group 1			60 min.		

Schedule of Weekly Program

The mental age of each child used for this study was obtained from the Terman-McNemar⁴⁰ Group Intelligence Test. It was first considered desirable to find the Standard Error of the differences and Critical Ratios between the three groups on mental ages to see if the hypothesis that these groups were controlled might be assumed to be correct. Mills⁴¹ has this to say:

If a given difference between hypothetical and observed values would occur as a result of chance only 1 time out of 100, or less frequently, we may say that the difference is significant. This means that the results are not consistent with the hypothesis we have set up. If the discrepancy between theory and observation might occur more frequently than 1 time out of 100 solely because of the play of chance, we may say that the difference is not clearly significant. The results are not inconsistent with the hypothesis. The value of T (the difference between the hypothetical value and the observed mean, in units of the Standard Error of the mean) corresponding to a probability of 1/100 is 2.576. One hundredth part of the area under the normal curve lies at a distance from the mean, on the x-axis, of 2.576 standard deviation, or more. Accordingly, tests of significance may be applied with direct reference to T, interpreted as a normal deviate (i.e. as a deviation from the mean of a normal distribution expressed in units of the standard deviation.) A value of T of 2.576 or more indicates a significant difference, while a value of less than 2.576 indicates that the results are not inconsistent with the hypothesis in question.

⁴⁰ Lewis Terman and Quinn McNemar, Terman-McNemar Test of Mental Ability, Form C (Yonkers-on-Hudson, New York: World Book Company, Copyright, 1941).

⁴¹ Frederick C. Mills, Statistical Methods (Revised) (New York: Henry Holt and Company, 1938), p. 471.

In the light of the above information any group with a Critical Ratio of less than 2.576 was interpreted as not statistically significant. Tables I, II, III show the results of the group analysis of mental ages.

TABLE I

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 2 ON M.A.

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{Diff.}$	C.R.
13.76	.26	.96	14	.06	.37	.162
M_2	σ_{M_2}	σ_2	N			
13.7	.26	.98	14			

TABLE II

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS 1 AND 3 ON M.A.

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{Diff.}$	C.R.
13.76	.26	.96	14	.04	.37	.108
M_2	σ_{M_2}	σ_2	N			
13.8	.26	.96	14			

TABLE III

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED
GROUPS 2 AND 3 ON M.A.

M_1	σ_{M_1}	σ_1	N	Diff. $M_1 - M_2$	$\sigma_{\text{Diff.}}$	C.R.
13.7	.26	.98	14	.1	.37	.027
M_2	σ_{M_2}	σ_2	N			
13.8	.26	.96	14			

Tables I, II and III show the Critical Ratios between the three groups running so far below the standard of 2.576 for statistical significance that they may be considered equal in mental ages.

The Buffalo Spelling Scale, Grades 2-8, Form A,⁴² was administered at the beginning of the study and Form B at the end of the study. It was also considered desirable to find the Standard Error of Differences and Critical Ratios between the three groups on the results of Form A, to see if the hypothesis that the three groups were controlled as to spelling abilities might also be assumed to be correct. Tables IV, V and VI show the results of the group analysis of spelling abilities.

⁴² Allan J. Williams, compiler, Buffalo Spelling Scale, Form A and Form B Grades 2-8 (Bloomington, Illinois: Public School Publishing Company).

TABLE IV

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS
1 AND 2 ON BUFFALO SPELLING SCALE, FORM A

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{Diff.}$	C.R.
7.5	.24	.91	14	.5	.33	1.52
M_2	σ_{M_2}	σ_2	N			
8.0	.23	.88	14			

TABLE V

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS
1 AND 3 ON BUFFALO SPELLING SCALE, FORM A

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{Diff.}$	C.R.
7.5	.24	.91	14	.4	.31	1.29
M_2	σ_{M_2}	σ_2	N			
7.9	.20	.76	14			

TABLE VI

SIGNIFICANCE OF DIFFERENCES BETWEEN CONTROLLED GROUPS
2 AND 3 ON BUFFALO SPELLING SCALE, FORM A

M_1	σ_{M_1}	σ_1	N	Diff. $M_1 - M_2$	$\sigma_{\text{Diff.}}$	C.R.
8.0	.23	.88	14	.1	.30	.33
M_2	σ_{M_2}	σ_2	N			
7.9	.20	.76	14			

Tables IV, V and VI show the Critical Ratios between the three groups running higher than for the mental ages, particularly for Groups 1 and 2 and Groups 1 and 3, but still far below the standard of 2.576 for statistical significance. It can thus be assumed that the three groups are equal as to spelling abilities.

The study covered a twelve week period. The city used for the experiment was a residential one close to Boston and composed of better than average homes for the most part. The children from these homes have all the comforts and advantages to be expected from such circumstances. There is, however, a small group of children from definitely underprivileged homes where both parents may be working and the children left to take care of themselves, or of general poverty and unsanitary living

conditions. There is practically no foreign element and therefore the problem of a language difficulty is eliminated. The school system is considered a progressive one with itinerant teachers for the physically handicapped, posture classes, and extra-curricular activities.

Ninety words from the required spelling list for seventh and eighth grades were taught during the first six weeks of the testing period. At the end of that time the same sentence test composed of the ninety words taught was given to all three groups to test retention. Ninety more words were taught during the next six weeks and another sentence retention test given. The results of this test were compared with the previous sentence retention test.

Fifteen new words and five review words were assigned each week. The following method was used for each of the three groups. A presentation of the new words for the week was made. Each word was pronounced distinctly by the teacher and written on the board as she said it. Similarities to known words were pointed out, attention was called to double letters, difficult parts were stressed, small words were found within the main word, endings and the number of syllables were noted. The class then tried to visualize the word without looking at it, saying it softly or writing it, and then comparing it with the printed form. Meanings were discussed, and those not known were looked up in the dictionary. Each new word was used in a sentence, sometimes orally and sometimes written. The words

were then dictated and corrected to find those needing further study. Specific directions for independent study were given. A record was kept of the words failed most often and these words were given the most attention. Thus, if the word "recommended" was misspelled twelve times, and the word "information" only three times, the former word might be written and compared eight times, and the latter only twice. Stress was laid on the fact that mere writing of the word was of no value unless a thoughtful attempt was made to visualize its form and then make a comparison with the printed form after writing the word.

Each new list of words was tested and graded once a week with each child keeping an individual spelling book with his work and score listed. The back of the spelling book was arranged in alphabetical order and each word misspelled in the weekly test was written correctly under the proper letter. These words were studied independently and as time allowed, an individual test was given each child on his own particular spelling demons. A red line was then drawn through those he had learned leaving those not cancelled for still further study. A table of weekly scores was kept for motivation.

As previously mentioned, at the end of six weeks the same test composed of sentences using the ninety words studied during that period was given to all three groups to measure retention. The test follows:

SENTENCE RETENTION TEST I

1. Do you consider that science will benefit a considerable amount by the construction of ten new buildings?
2. The prosperous merchant carried a diamond concealed in an unusual envelope everywhere he went in Europe.
3. His appearance was especially against him when he applied for the job of reading the gas meter.
4. She was a mere child when I last saw her.
5. A thorough study was made of the increasing lack of convenient passenger trains.
6. He did not behave as he always had formerly when making out his application for provisions.
7. The fog will envelop the countryside this forenoon.
8. He is going to undertake to develop an independent study of the habits of reindeer.
9. The severe storm gave me a great fright, particularly when the very foundation of the house simply trembled.
10. Did it occur to you to ask his pardon, rather than to offend him by going into further detail over a difficult matter?
11. No provision was made for an expression of public opinion.
12. He did not indicate that there would be any prospect of a job in the orchestra.

13. Will you relate your explanation of your entry into his house?

14. The minister said that a sense of believing in good will influence one's purpose in life.

15. The seasons slip by so quickly that it is with difficulty that we can separate the approach of one from another.

16. We can appreciate the opera more perfectly if we consult the program first.

17. I was uneasy until the first three sections of the freight train loaded with a mixture of gasoline and explosives had passed.

18. The little orphan was careful to remedy his mistake before the patience of the carpenter was exhausted.

19. What rule can you apply to this problem?

20. Even though he was a capable man he could not establish an urge to attend the convention.

21. It is easy to misspell the word "disappear."

22. Did he inquire whether the bill for goods purchased was payable, or if he should remit the same?

23. The falling of the trees in the orchard was likely to both frighten and injure the child.

24. The people of the republic were not united.

25. Oil now sells at twenty cents a gallon.

26. The house was thirty ft. by twenty ft.

13. Will you relate your explanation of your entry into his house?
14. The minister said that a sense of believing in good will influence one's purpose in life.
15. The seasons slip by so quickly that it is with difficulty that we can separate the approach of one from another.
16. We can appreciate the opera more perfectly if we consult the program first.
17. I was uneasy until the first three sections of the freight train loaded with a mixture of gasoline and explosives had passed.
18. The little orphan was careful to remedy his mistake before the patience of the carpenter was exhausted.
19. What rule can you apply to this problem?
20. Even though he was a capable man he could not establish an urge to attend the convention.
21. It is easy to misapprehend the word "disappear."
22. Did he inquire whether the bill for goods purchased was payable, or if he should remit the same?
23. The falling of the trees in the orchard was likely to both frighten and injure the colts.
24. The people of the republic were not united.
25. Oil now sells at twenty cents a gallon.
26. The house was thirty ft. by twenty ft.

Six weeks later the second retention test composed of the ninety words taught during that period was given to all three groups. The results from this test were compared with those from the first test. The test follows:

SENTENCE RETENTION TEST II

1. The governor did wonderfully well on his new trolley transportation system in the neighborhood.
2. The tobacco company will advertise its new source of supply in the near future.
3. "That is a peculiar instrument!" exclaimed the gracious patron of the music club.
4. I don't quite know whether I should make an exception of the text submitted to the council.
5. The wireless tower was not a usual type seen at such a distance.
6. We'll govern the traffic problem as exactly as possible.
7. Can you possibly substitute one assignment for the other as a personal favor?
8. Did the disappearance of the queer visitor convince you that he was not a ghost?
9. The examiner can instantly distinguish between pleasant and stormy weather reports.
10. He was forced to resign his position solely because of an incomplete report.

11. Can you gradually stretch the twine to meet the requirements of the measurements assigned?

12. Upon his arrival at his new residence he began at once to dispose of quantities of valuable furniture.

13. Water is the natural home of the muskrat.

14. We've had an invitation to join the new society being formed on domestic relations.

15. Whoever can hit the ball with one stroke will win a splendid prize for the strength and quality of his performance.

16. The widow left for a tour of Spain and Asia.

17. We can't tell the exact amount of moisture unless we examine the stalk we now possess.

18. There is no instance of a disease which will correspond with this one.

19. The moral of this story is to be generous.

20. I'd like some instruction in the mixing of cement.

21. The celebration of the republican party will cease at midnight.

22. The package marked "pd." weighed less than one oz.

Form B of the Buffalo Spelling Scale was administered at the end of the twelve weeks.

Significance of differences was found on the following points:

1. Sentence Test I results with Sentence Test II results on Controlled Group 1.

2. Sentence Test I results with Sentence Test II results on Controlled Group 2.

3. Sentence Test I results with Sentence Test II results on Controlled Group 3.

4. The Buffalo Spelling Scale, Form A with the Buffalo Spelling Scale, Form B on Controlled Group 1.

5. The Buffalo Spelling Scale, Form A with the Buffalo Spelling Scale, Form B on Controlled Group 2.

6. The Buffalo Spelling Scale, Form A with the Buffalo Spelling Scale, Form B on Controlled Group 3.

The following chapter deals with the analysis of data taken during the experiment.

CHAPTER IV

THE ANALYSIS OF DATA

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As the mental ages and spelling abilities of the three groups may be considered to be equal as shown by the data obtained in Chapter III, the analysis of data will center around the achievement in spelling when using spaced learning versus the achievement when using massed, or unspaced learning.

The Standard Error of the Difference and the Critical Value was found on the raw scores of Sentence Retention Tests I and II with the same standard of 3.576 as a Critical Value.

CHAPTER IV

and also on the Buffalo Spelling Series, Form A with Form B.

The tables follow THE ANALYSIS OF DATA for these tests on the three groups.

TABLE VII

SIGNIFICANCE OF DIFFERENCES BETWEEN SENTENCE RETENTION TESTS I AND II ON CONTROLLED GROUP 1

\bar{X}_1	$\sigma_{\bar{X}_1}$	σ^2_1	N	Significance		
84.79	2.41	5.83	14	2.4%	2.85	.01
\bar{X}_2	$\sigma_{\bar{X}_2}$	σ^2_2	N			
85.06	1.45	2.10	24			

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The Standard Error of the differences and the Critical Ratio was found on the raw scores of Sentence Retention Tests I and II with the same standard of 2.576 as a Critical Ratio, and also on the Buffalo Spelling Scale, Form A with Form B. The tables following show the results of these tests on the three groups.

TABLE VII

SIGNIFICANCE OF DIFFERENCES BETWEEN SENTENCE RETENTION TESTS I AND II ON CONTROLLED GROUP 1

M_1	σ_{M_1}	σ_1	N	Diff. $M_1 - M_2$	$\sigma_{\text{Diff.}}$	C.R.
84.79	2.41	9.03	14	1.29	2.82	.46
M_2	σ_{M_2}	σ_2	N			
86.08	1.48	5.52	14			

TABLE VIII

SIGNIFICANCE OF DIFFERENCES BETWEEN SENTENCE RETENTION
TESTS I AND II ON CONTROLLED GROUP 2

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{\text{Diff.}}$	C.R.
80.08	3.77	14.10	14	5.13	4.65	1.10
M_2	σ_{M_2}	σ_2	N			
85.21	2.72	9.18	14			

TABLE IX

SIGNIFICANCE OF DIFFERENCES BETWEEN SENTENCE RETENTION
TESTS I AND II ON CONTROLLED GROUP 3

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{\text{Diff.}}$	C.R.
82.55	3.07	11.49	14	3.45	3.18	1.08
M_2	σ_{M_2}	σ_2	N			
86.0	.83	3.09	14			

The Critical Ratios on Tables VII, VIII and IX all run far below the criterion of 2.576 and are not statistically significant.

TABLE X

SIGNIFICANCE OF DIFFERENCES BETWEEN BUFFALO SPELLING
SCALE, FORM A WITH FORM B, ON CONTROLLED GROUP 1

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{\text{Diff.}}$	C.R.
7.5	.24	.91	14	.4	.36	1.11
M_2	σ_{M_2}	σ_2	N			
7.9	.27	1.08	14			

TABLE XI

SIGNIFICANCE OF DIFFERENCES BETWEEN BUFFALO SPELLING
SCALE, FORM A WITH FORM B, ON CONTROLLED GROUP 2

M_1	σ_{M_1}	σ_1	N	Diff. M_1-M_2	$\sigma_{\text{Diff.}}$	C.R.
8.0	.23	.88	14	.6	.41	1.46
M_2	σ_{M_2}	σ_2	N			
8.6	.34	1.29	14			

TABLE XII

SIGNIFICANCE OF DIFFERENCES BETWEEN BUFFALO SPELLING
SCALE, FORM A WITH FORM B, ON CONTROLLED GROUP 3

M_1	σ_{M_1}	σ_1	N	Diff. $M_1 - M_2$	$\sigma_{\text{Diff.}}$	C.R.
7.9	.20	.76	14	.5	.42	1.19
M_2	σ_{M_2}	σ_2	N			
8.4	.26	.96	14			

SUMMARY AND CONCLUSIONS

The Critical Ratios on Tables X, XI and XII, although running somewhat higher than on Tables VII, VIII and IX, are below the criterion set and are not statistically significant.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this investigation was to answer the following questions:

1. Is more gain found when using spaced learning in spelling or when using unspaced learning in spelling?
2. At what interval does the most learning seem to be found, at twenty minute intervals three times a week, or at thirty minute intervals twice a week?

CHAPTER V

SUMMARY AND CONCLUSIONS

The data obtained from the Sentence Retention Tests and the Buffalo Spelling Scale, Forms A and B, were analyzed statistically with the conclusions which follow:

1. There was no more statistically significant gain to be found in spelling achievement when using spaced learning than when using unspaced learning.
2. There was no more statistically significant gain to be found in learning at intervals of three times a week than at intervals of twice a week.

However, it is interesting to note in examining the data the following points:

1. Although there were no statistically significant differences on the Sentence Retention Test

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2. There was no more statistically significant gain to be found in learning at intervals of three times a week than at intervals of twice a week.

However, it is interesting to note in examining the data the following points:

1. Although there were no statistically significant differences on the Sentence Retention Test

results on the three groups, Groups 2 and 3 showed considerably higher Critical Ratios of 1.10 and 1.08 as compared with .46 for Group 1. This seems to indicate a slight trend toward higher Critical Ratios for the spaced learning groups than for the unspaced learning group. It is readily acknowledged that these were raw scores obtained from test results in which the words to be tested were not equated for difficulty and so cannot be considered valid tests. This trend is mentioned, however, because it follows the same general pattern to be found in the point following.

2. Again no statistically significant differences were found on the Buffalo Spelling Scale, Form A with Form B, on the three groups, but the same trend toward higher Critical Ratios for the spaced learning groups than for the unspaced learning group may be seen. Groups 2 and 3 showed Critical Ratios of 1.46 and 1.19 as compared with 1.11 for the unspaced learning Group 1.
3. A slight trend was shown toward more learning for the thirty minute interval twice a week group than for the twenty minute interval three times a week group, with higher Critical Ratios on both tests, though not statistically significant.

It is realized that twelve weeks is a short time to measure any learning process. Had this experiment been carried over an entire school year it is possible that these trends toward more gain in spelling achievement when using spaced learning than when using unspaced learning might have become statistically significant.

CHAPTER VI

SUGGESTIONS FOR FURTHER RESEARCH

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1. The words to be taught in the first period of the study should be equated for difficulty with those to be taught in the second period of the study.
2. A study of spaced learning in spelling versus unspaced learning in spelling should be made with larger groups of children chosen from other areas than the one used in this study.

CHAPTER VI

SUGGESTIONS FOR FURTHER RESEARCH

3. A study of this sort might be carried over a much longer period of time, as an entire school year, to show statistically significant gains in spelling achievement when using spaced learning.
4. It might be of interest to discover differences of boys and girls in spaced and unspaced learning in spelling.
5. A comparison might be made of the Intermediate grade level with the Junior High level using spaced and unspaced learning to see if the same conclusions hold true for both levels in spelling achievement.

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2. A study of spaced learning in spelling versus unspaced learning in spelling should be made with larger groups of children chosen from other areas than the one used in this study.
3. A study of this sort might be carried over a much longer period of time, as an entire school year, to see if the trends indicated in Chapter V would show statistically significant gains in spelling achievement when using spaced learning.
4. It might be of interest to discover differences of boys and girls in spaced and unspaced learning in spelling.
5. A comparison might be made of the Intermediate grade level with the Junior High level using spaced and unspaced learning to see if the same conclusions hold true for both levels in spelling achievement.

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WORDS TAUGHT DURING THE STUDY

<u>Week I</u>	<u>Week II</u>	<u>Week III</u>
1. consider	considerable	benefit
2. appearance	believing	construction
3. behave	application	applied
4. forenoon	formerly	more
5. detail	develop	independent
6. entry	offend	particularly
7. pardon		diamond
8. increasing	explanation	foundation
9. merchant	prosperous	envelope
10. thorough	undertake	uneasy
11. prospect	seasick	provision
12. science	water	sections
13. reload	indicate	opera
14. occur	passenger	expression
15. Europe	envelop	thoroughly
Review	appearance	formerly
	thorough	envelop
	science	infinite
	occur	prosperous
	increasing	considerable

APPENDIX

WORDS TAUGHT DURING THE STUDY

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<u>Week I</u>	<u>Week II</u>	<u>Week III</u>
1. consider	considerable	benefit
2. appearance	believing	construction
3. behave	application	applied
4. forenoon	formerly	mere
5. detail	develop	independent
6. entry	offend	particularly
7. pardon	relate	diamond
8. increasing	explanation	foundation
9. merchant	prosperous	envelope
10. thorough	undertake	uneasy
11. prospect	seasons	provision
12. science	meter	sections
13. reindeer	indicate	opera
14. occur	passenger	expression
15. Europe	envelop	thoroughly
Review	appearance	formerly
	thorough	envelop
	science	indicate
	occur	prosperous
	increasing	considerable

Week IV

1. consult
2. apply
3. capable
4. especially
5. difficult
6. freight
7. influence
8. patience
9. minister
10. provisions
11. united
12. sense
13. ft.
14. orphan
15. remedy

Week V

- convenient
- appreciate
- careful
- difficulty
- fright
- establish
- injure
- payable
- misspell
- purchased
- unusual
- separate
- orchard
- gallon
- remit

Week VI

- carpenter
- disappear
- republic
- gasoline
- approach
- convention
- orchestra
- urge
- purpose
- simply
- mixture
- inquire
- perfectly
- everywhere
- frighten

Review

- envelope
- relieve
- experience
- actual
- independent

- experience
- especially
- freight
- patience
- sense

- convenient
- appreciate
- separate
- unusual
- patience

Week VII

1. cease
2. republican
3. gracious
4. arrival
5. convince
6. oz.
7. usual
8. quality
9. splendid
10. personal
11. instance
12. moisture
13. exact
14. furniture
15. disappearance

Week VIII

- celebration
- requirement
- Asia
- correspond
- exactly
- disease
- future
- moral
- pleasant
- instantly
- quantities
- valuable
- stalk
- gradually
- pd.

Week IX

- council
- residence
- assigned
- cement
- examine
- generous
- I'd
- patron
- strength
- queer
- visitor
- position
- instruction
- muskrat
- dispose

- Review
- disappear
 - approach
 - orchestra
 - separate
 - purpose

- gracious
- disappearance
- cease
- moisture
- exact

- quantities
- stalk
- correspond
- valuable
- disease

<u>Week X</u>	<u>Week XI</u>	<u>Week XII</u>
1. ghost	text	stroke
2. distance	society	wonderfully
3. examiner	we'll	trolley
4. govern	solely	submitted
5. distinguish	we've	twine
6. incomplete	tobacco	type
7. resign	whoever	substitute
8. peculiar	source	domestic
9. stretch	tower	exclaimed
10. quite	widow	governor
11. whether	Spain	invitation
12. natural	traffic	neighborhood
13. instrument	stormy	possibly
14. possess	transportation	advertise
15. exception	wireless	assignment
Review		
dispose	distinguish	source
gradually	peculiar	text
exactly	whether	solely
residence	exception	disappear
council	possess	society

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